Salmonellosis (Nontyphoidal)

Manitoba

Communicable Disease Control Branch

1. Case Definition

1.1 Confirmed Case

Laboratory confirmation of infection with or without clinical illness[a].

- Isolation of *Salmonella* sp. (excluding *Salmonella typhi* and *paratyphi*) from an appropriate clinical specimen (e.g., sterile site, deep tissue wounds, stool or urine) (1).

1.2 Probable Case

Clinical illness[a] in a person who is epidemiologically linked to a confirmed case (1).

2. Reporting Requirements

Laboratory:

- All positive results from laboratory tests are reportable to the Public Health Surveillance Unit (204-948-3044 secure fax).
- Clinical laboratories are required to submit isolate sub-cultures from individuals who tested positive for *Salmonella* sp. to Cadham Provincial Laboratory (CPL) within seven days of report.

Health Care Professional:

- The *Salmonella Questionnaire* available at: www.gov.mb.ca/health/publichealth/surveillance/salmonella_questionnaire.pdf should be completed for all cases.

3. Clinical Presentation/Natural History

The most common presentation of nontyphoidal *Salmonella* infection is self-limited acute gastroenteritis that is indistinguishable from that caused by many other enteric bacterial pathogens (2, 3). Diarrhea, abdominal cramps and fever are common symptoms (2). Headache, nausea, vomiting, myalgias and other systemic symptoms may also occur (3, 4). Illness usually lasts four to seven days and most people recover without treatment (5). Dehydration, especially among infants or in the elderly, may be severe (4). Asymptomatic infection may occur (1) or infection may develop into sepsis or focal infection (e.g., meningitis, osteomyelitis) (2). The elderly, infants and those with impaired immune systems are more likely to have a severe illness (3, 6). A small number of individuals develop joint pain, eye irritation and painful urination (Reiter syndrome) following *Salmonella* infection (7).

4. Etiology

Salmonella species are gram negative bacilli of the family *Enterobacteriaceae* (2). Over 2,500 serotypes of *Salmonella* have been identified (4). Nearly all *Salmonella* isolated from ill individuals are serotypes of *S. enterica*, subspecies *enterica* (4). Serotypes are usually named after the location where they were first isolated (e.g., Heidelberg, Newport) but some serotypes are designated by a formula based on their patterns of surface antigen expression (e.g., ssp| 4, [5], 12:i:-) (3, 8, 9).

5. Epidemiology

5.1 Reservoir and Source

The intestinal tracts of domestic and wild animals (5), mainly poultry, livestock, reptiles and pets (e.g., cats, dogs, birds, rodents) (2, 10). Contamination of raw poultry and meat products can occur during slaughter and processing (3). Asymptomatic human carriers (11) and cases who are convalescing also serve as reservoirs (4).

a Headache, diarrhea, abdominal pain, nausea , fever and sometimes vomiting. The organism may cause extra-intestinal infections.

5.2 Transmission

Salmonella is transmitted mainly by improperly cooked food of animal origin such as meat, poultry and eggs as well as dairy products (2, 4, 5), but also occurs through contact with infected animals, humans or their feces (2, 4). Other foods (e.g., fruits, vegetables, peanut butter, frozen pot pies, powdered infant formula, bakery products) have been implicated in outbreaks in which the food was contaminated by contact with an infected animal product or human (2). Epidemics have also been traced to foods prepared or processed with contaminated utensils or on contaminated work surfaces or by foods contaminated by the feces of an infected food handler. Ingestion of contaminated water or contact with infected animals, including reptiles (e.g., pet turtles, snakes and lizards) or amphibians (e.g., frogs, salamanders) and/or their environment may lead to infection with *Salmonella* (2, 4). Exposure to unsterilized pharmaceuticals of animal origin is a potential source of infection (4). Animal-derived pet treats have been associated with outbreaks of human *Salmonella* (12). Person-to-person fecal-oral transmission is possible, especially when diarrhea is present; infants and stool-incontinent adults pose a greater risk of transmission than do asymptomatic carriers (3). The risk of transmission of *Salmonella* from health care workers to patients is low if infection control measures are followed (3).

5.3 Occurrence

General: Sporadic disease is more common than outbreaks (13) but widespread outbreaks in the community, restaurants, health care institutions and nursing homes have been reported (4). Only a small proportion of cases are recognized clinically (4). It is estimated that approximately 93.8 million cases of nontyphoidal *Salmonella* gastroenteritis occur globally each year with 155,000 deaths (14). An estimated 80.3 million are foodborne (14). Reported incidence is highest in infants and young children (4, 15) and the elderly (2). The incidence of nontyphoidal *Salmonella* infection is highest during the rainy season in the tropical climates and during the warmer months in temperate climates, coinciding with the peak in foodborne outbreaks (3, 15).

Canada: The reported isolation rate is an under-representation of actual infections as not all people exhibiting symptoms of gastroenteritis seek medical care and not all isolations of *Salmonella* are reported. The reported incidence rate for *Salmonella* in 2008 was 18.2 per 100,000 population (16). The reported incidence rate was highest (64 per 100,000) in children less than one year of age (16). The reported incidence was lowest (14.5 per 100,000) in both the 10-14 year and 40-59 year age groups (16). In 2009, 30% of *Salmonella* cases reported to C-EnterNet were travel-related (17).

Manitoba: The reported incidence rate was 21.7 per 100,000 population in 2009 (263 cases) and 18.9 per 100,000 population in 2010 (232 cases). For 2000-2010 inclusive, the mean incidence rate was highest in the < 1 year age group (46.1 per 100,000) followed by the 1-4 year age group (31 per 100,000) and lowest in the 10-14 year age group (12.2 per 100,000).

5.4 Incubation Period

From six to 72 hours depending on the host and the inoculum size (9), usually 12-36 hours (2, 4).

5.5 Host Susceptibility

Susceptibility is general and increased by achlorhydria, antacid treatment, gastrointestinal surgery, prior or current broad-spectrum antibiotic therapy, neoplastic disease, immune compromising conditions (e.g., HIV infection) or treatment and other debilitating conditions such as malnutrition (4). Severity of disease is related to serotype, number of organisms ingested and host factors (4). Residents of nursing homes are at increased risk of more severe morbidity and mortality because of the presence of comorbid illnesses, acid-suppressing medications and waning immunity (3).

5.6 Period of Communicability

Extremely variable, usually several days to several weeks depending on the course of infection (4). A temporary carrier state may continue for months or longer, especially in infants (4). Antimicrobial therapy may prolong fecal excretion (2, 18).

5.7 Antimicrobial Resistance

Salmonella serotypes that are resistant to core antimicrobials including ampicillin, chloramphenicol, streptomycin, sulphonamides and tetracycline have been identified (19). Isolates have been identified which are also resistant to fluoroquinolones, trimethoprim and kanamycin (19).

6. Laboratory Diagnosis

Isolation of *Salmonella* from an appropriate clinical specimen (e.g., sterile site, deep tissue wounds, fresh stool or urine). When foodborne illness is suspected, "suspected foodborne illness" should be indicated on the requisition. A single stool specimen will be positive in most symptomatic patients, but excretion of the organism may be intermittent in asymptomatic carriers. Serotyping is performed on all isolates submitted to Cadham Provincial Laboratory. Susceptibility testing is available and performed according to standard laboratory protocols.

7. Key Investigations for Public Health Response

- Stool culture is recommended for:
  - symptomatic contacts;
  - asymptomatic contacts who are food handlers, hospital attendants or who may be a source for an outbreak or nosocomial transmission.
- Collection of implicated food/water samples for testing (usually performed by Public Health Inspectors). Refer to the *Enteric Illness Protocol* available at: www.gov.mb.ca/health/publichealth/cdc/protocol/enteric.pdf

8. Control

8.1 Management of Cases

- Education should be provided on personal and food hygiene (e.g., importance of hand washing after defecation and before handling food).
- Exclusion from food handling and from direct care of infants and young children, the elderly and immunocompromised and institutionalized patients should be considered until 48 hours after the last symptoms. Individuals who continue to exhibit intermittent symptoms should be handled on a case-by-case basis at the discretion of the Medical Officer of Health.
- Exclusion of attendance should be considered for infected young children attending child care facilities who are diapered or unable to practice good personal hygiene, until they are asymptomatic. Children who continue to exhibit intermittent symptoms should be handled on a case-by-case basis at the discretion of the Medical Officer of Health.
- Re-assignment of work duties may be considered as an alternative to exclusion (e.g., food handlers not working with unwrapped food to be consumed raw or without further cooking) (3).
- Carriers[b] must be advised to be especially scrupulous in their hand washing after defecation and before handling food.

Infection Control Measures: Contact Precautions are indicated in children who are incontinent or unable to comply with hygiene and should be considered for incontinent adults if stool cannot be contained or for adults with poor hygiene who contaminate their environment. Otherwise, Routine Practices are adequate.

Treatment:

- Hydration and electrolyte replacement (3, 8).
- Antidiarrheal agents are not recommended as they may extend the gastrointestinal transit time and lengthen the clinical course of illness (8).

b Defined as persons whose feces or urine still contain the bacterium more than 12 months after the onset of initial illness (8).

- Antimicrobial treatment is not usually indicated for healthy individuals with asymptomatic infection or uncomplicated (noninvasive) gastroenteritis (2-4, 18) because therapy does not shorten the duration of diarrheal illness and can prolong the duration of fecal excretion (2).
- Antibiotic treatment is recommended for cases with extra-intestinal infection (e.g., sepsis) and cases with gastroenteritis who are at increased risk of invasive disease including:
  - Infants < 3 months of age (2, 3). Some experts suggest that those less than one year of age should also be treated (9);
  - The elderly (4); and
  - Those with:
    - Chronic gastrointestinal tract disease (2);
    - Cardiac valvular or endovascular abnormalities (3);
    - Malignant neoplasms (2);
    - Hemoglobinopathies (2);
    - Immunosuppressive illnesses or therapies (e.g., HIV infection) (2, 3);
    - Significant joint disease (3, 18);
    - Other debilitating disease(s) (4).

  Ampicillin, amoxicillin or trimethoprim-sulfamethoxazole is recommended (2-4). Therapy may need to be modified based on susceptibility. Severe extra-intestinal infections are commonly treated with ceftriaxone or fluoroquinolones such as ciprofloxacin in adults, and with third-generation cephalosporins such as ceftriaxone in children (20). Infectious disease consultation is recommended.
- In adults, empiric therapy for life-threatening sepsis or focal infection suspected to be caused by nontyphoidal *Salmonella* should include an expanded spectrum beta-lactam or carbapenem until antimicrobial susceptibilities are known, then therapies should be modified based on the susceptibilities (3). Infectious disease consultation is recommended. A pediatric infectious diseases specialist (204-787-2071) should be consulted for cases in children. Antimicrobial resistance may necessitate the selection of other agents. Infectious disease consultation is recommended.

8.2 Management of Contacts

- Symptomatic contacts should be managed as cases (refer to Section 8.1 *Management of Cases*).
- Screening of stool specimens of asymptomatic contacts in the course of an investigation is necessary only for food handlers, hospital attendants and other situations where the spread of infection is likely. If stool specimens are positive, refer to Section 8.1 *Management of Cases*.

8.3 Management of Outbreaks

An outbreak is defined as the occurrence of case(s) in a particular area and period of time in excess of the expected number of cases.

- Outbreaks should be investigated to identify a common source of infection and prevent further exposure to that source. The extent of outbreak investigations will depend upon the number of cases, the likely source of contamination and other factors.
- Refer to the *Enteric Illness Protocol* available at:
  www.gov.mb.ca/health/publichealth/cdc/protocol/enteric.pdf
- Public notification should occur. The level of notification will usually be at the discretion of regional Public Health and/or the provincial Public Health Division for local outbreaks but may be at

the discretion of the Federal Government for nationally linked foodborne outbreaks as per Canada's Foodborne Illness *Outbreak Response Protocol (FIORP) 2010: To guide a multijurisdictional response* available at:

www.phac-aspc.gc.ca/zoono/fiorp-pritioa/index-eng.php

- Education on preventive measures should occur (refer to Section 8.4 below).

8.4 Preventive Measures

Industry:

- Inspection and adequate supervision of abattoirs, food processing plants, feed blending mills, egg grading stations and butcher shops.
- Reduction or more restricted use of antimicrobial agents for non-therapeutic agricultural purposes (9, 21).
- More rigorous testing for pathogens or better methods of infection control for foods that will be consumed in a raw or fresh state (22).
- Implementation of a bactericidal step in the processing of pet treats, such as heat treatment or irradiation (12).

Food Handling and Consumption:

- Good personal hygiene practices in food handlers (3).
- Appropriate storage and refrigeration of food (23).
- Cross-contamination of foods should be avoided:
  - Uncooked meats should be kept separate from produce, cooked foods and ready-to-eat foods.
  - Hands, food preparation surfaces and utensils should be cleaned after touching uncooked foods.
  - Hands should be washed with soap and water before handling food and between handling different food items (7).
  - Utensils and surfaces used to prepare raw food should never come in contact with cooked foods or foods that will be eaten raw (24).
- Produce should be thoroughly washed before being eaten (7).
- Raw or unpasteurized milk or other dairy products should not be consumed (7).
- Encourage breast feeding for infants.
- Raw eggs, foods containing raw eggs or incompletely cooked eggs should not be consumed (2, 4). Pasteurized or irradiated eggs should be used whenever possible (3, 4).
- Thorough cooking of eggs and other foods of animal origin before consumption (2). The following internal cooking temperatures are recommended:
  - 63°C (145°F) for all whole cuts of meat (allow 3 minutes resting time before carving/consuming) and fish;
  - 71°C (160°F) for all ground meats and egg dishes; and
  - 74°C (165°F) for all whole and ground poultry (chicken and turkey) including stuffing and casseroles (25).

More information is available at:

http://www.fsis.usda.gov/is_it_done_yet/thermometer_placement_and_temps/index.asp

- When travelling in developing countries, raw foods that cannot be peeled, cooked foods that are not hot, food from street vendors and drinks with ice should be avoided (23).

Community:

- Education in personal hygiene, especially good hand washing.
- Provision of safe and adequate water supplies and hand washing facilities.
- Sanitary sewage disposal (2).
- Exclusion of symptomatic people from handling food or providing health care (2).

Pets and Other Animals:

- Reptiles (e.g., turtles, snakes, lizards) and amphibians (e.g., frogs, salamanders) should not be kept as pets (5) or if they are kept as pets, customers should be better informed about the risks of ownership (26). Acquisition and ownership of non-traditional pets should be discouraged in households with young children (2).
- Child care facilities should not have reptiles and amphibians on the premises due to the increased risk of salmonellosis outbreaks.
- Thorough hand washing with soap and water immediately after handling animals, reptiles or birds or after contact with their environment or food (4, 7, 12, 20, 27).
- Pet store owners, health-care providers and veterinarians should provide information to pet owners about the potential risks of animal-derived pet treats and prevention of salmonellosis (12).
- People at increased risk for infection or serious complications of salmonellosis (e.g., children < 5 years, elderly and immunocompromised people) should avoid contact with animal-derived pet treats (12).
- Infants should be kept away from pet feeding areas (6).

References

1. Public Health Agency of Canada. Case Definitions for Communicable Diseases under National Surveillance. *Canada Communicable Disease Report CCDR* 2009; 35S2: 1-123.
2. American Academy of Pediatrics. *Salmonella* Infections. In: Pickering LK ed. *Redbook 2009 Report of the Committee on Infectious Diseases 28th ed.* Elk Grove Village, IL: American Academy of Pediatrics, 2009; 584-589.
3. Pegeus DA and Miller SI. *Salmonella* Species, Including *Salmonella Typhi*. In: Mandell GL, Bennett JE, Dolin R eds. *Principles and Practice of Infectious Diseases 7th ed.* 2009; 2887-2903, Elsevier, Philadelphia.
4. Heymann DL. Salmonellosis. In: *Control of Communicable Diseases Manual 19th ed,* American Public Health Association, Washington, 2008; 534-540.
5. Health Canada. Salmonella Prevention. Available at: http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/food-aliment/salmonella-eng.php
6. Centers for Disease Control and Prevention. Multistate Outbreak of Human *Salmonella* Infections Caused by Contaminated Dry Dog Food – United States, 2006-2007. *Morbidity and Mortality Weekly MMWR* 2008; 57(19): 521-524.
7. Centers for Disease Control and Prevention. Salmonellosis: General Information. November 2009.
8. Crum Cianflone NF. Salmonellosis and the GI Tract: More than Just Peanut Butter. *Curr Gastroenterol Rep* 2008; 10(4): 424-431.
9. Hohmann EL. Nontyphoidal Salmonellosis. *Clinical Infectious Diseases* 2001; 32: 263-269.
10. Centers for Disease Control and Prevention. *Salmonella* Infection (Salmonellosis) and Animals. Available at: http://www.cdc.gov/healthypets/diseases/salmonellosis.htm
11. Public Health Agency of Canada. Restaurant Foodhandler-Associated Outbreak of Salmonella-Heidelberg Gastroenteritis Identified by Calls to a Local Telehealth Service, Edmonton, Alberta, 2004. *Canada Communicable Disease Report CCDR* 2005; 31 (10): 105-110.
12. Public Health Agency of Canada. An International Outbreak of Human Salmonellosis Associated with Animal-Derived Pet Treats – Canada and Washington State, 2005. *Canada Communicable Disease Report CCDR* 2006; 32(13): 150-154.

13. World Health Organization. Drug-resistant Salmonella, April 2005. Available at: www.who.int/mediacentre/factsheets/fs139/en/.

14. Majowicz SE, Musto J, Scallon E *et al.* The Global Burden of Nontyphoidal *Salmonella* Gastroenteritis. *Clinical Infectious Diseases* 2010; 50: 882-889.

15. European Centre for Disease Control. Salmonellosis. Annual epidemiological report on communicable diseases 2010: 87-90.

16. Notifiable Disease Surveillance System, Surveillance and Epidemiology Division, Centre for Communicable Diseases and Infection Control, Public Health Agency of Canada (2005-2008).

17. Government of Canada. Canadian National Enteric Pathogen Surveillance System (C-EnterNet). Guelph, ON: Public Health Agency of Canada (2005-2009).

18. Thielman NM and Guerrant RL. Acute Infectious Diarrhea. *N Engl J Med* 2004; 350(1): 38-47.

19. National Microbiology Laboratory-Public Health Agency of Canada. Studies Involving Multidrug Resistant *Salmonella,* 2006. Available at: www.nml-lnm.gc.ca/eb-be/ARNI-RAIN-salmonella-eng.htm

20. Sjölund-Karlsson M, Howie R, Krueger A *et al.* CTX-M-producing Non-Typhi *Salmonella* spp. Isolated from Humans, United States. *Emerging Infectious Diseases* 2011; 17(1): 97-99.

21. Public Health Agency of Canada. *Salmonella* Heidelberg – Ceftiofur-Related Resistance in Human and Retail Chicken Isolates.

22. Centers for Disease Control and Prevention. *Salmonella* Senftenberg Infections and Fennel Seed Tea, Serbia. *Emerging Infectious Diseases* 2010; 16(5): 893-894.

23. Linam WM and Gerber MA. Changing Epidemiology and Prevention of *Salmonellla* Infections. *The Pediatric Infectious Disease Journal* 2007; 26(8): 747-748.

24. Weir E. Enhanced Surveillance for *Salmonella* Newport. *CMAJ* 2004; 171(2): 127-128.

25. United States Department of Agriculture Food Safety and Inspection Service. Is it Done Yet? Available at: http://www.fsis.usda.gov/is_it_done_yet/thermometer_placement_and_temps/index.asp

26. Harris, JR, Neil KP, Barton Behravesh C *et al.* Recent Multistate Outbreaks of Human *Salmonella* Infections Acquired from Turtles: A Continuing Public Health Challenge. *Clinical Infectious Diseases* 2010; 50: 554-559.

27. Public Health Agency of Canada. Factsheet – *Salmonella* and Pets. Available at: http://www.phac-aspc.gc.ca/alert-alerte/salmonella/advisory-avis_20110822-eng.php